B 52
N82
opy 1

METHOD

of finding the true cause of the Acceleration and Retardment of the

ECLIPSES OF JUPITER'S SATELLITES

without making use of the Progressive Velocity of Light, or the Movement of Light, in Space

—BY—

CAPT. JAMES W. NORCROSS,

716 CHAMBER OF COMMERCE BUILDING, INDIA ST., BOSTON.

Entered by Act of Congress the 15th of June, 1893.
By JAMES WINCHELL NORCROSS.
BOSTON, MASS.

LIBRARY OF CONGRESS
COPYRIGHT
JUL 10 1893
COPY FROM WASHINGTON.
28691

PREFACE.

LIKE the prospector, who after long and weary searching, has picked up an object with the shimmer of gold on its surface, feeling sure he had in his grasp the precious metal itself, only to find he held but dross, so has it been with the writer. Many trials, disappointments and some bitter lessons have engendered a certain timidity that has delayed the publication of this work, fearing that by some misconception or oversight he may have been misled. But careful examination reveals no flaw. All appears to be in perfect harmony with natural laws and teachings of the illustrious founders of modern astronomy. Not a glimpse of anything that could add to or change what he now ventures to put forth having appeared, and trusting his judgment has not erred, grateful if he has been permitted to be the instrument for unearthing truth from the error where it has so long lain buried, he now submits this problem to the attention and consideration of authorities so greatly superior to himself, trusting his efforts may have aided to promote the advancement of astronomy.

THE AUTHOR.

782

EXPLANATION.

After a long and patient search the writer is now fully convinced that he has found the true cause of the variation and that the Roemer theory of transmission has nothing at all to do with it.* He has never doubted a regulated speed of light in the atmosphere, but has always questioned the right to make use of an ether made to pervade all space and invented to be used as the means of regulating its movement. What is the ether? Certainly something hard to conceive. A something not subject to the law of gravitation, nor capable of resistance, and yet it is called on to perform the same service as the atmosphere and by means of vibrations convey light at a regular speed of 192,000 miles a second, and to cause it to move at the same speed in the densest of our atmosphere. This being so directly contrary to well-known natural laws has been the steady cause for stubborn disbelief in the whole theory, and two brief remarks that will be obvious will show the reason why: First—In nature's phenomena, such as heat, electricity, sound, and in which we may safely include light, the speed varies with variation in density. In this case these conditions are particularly applicable to light which by the Roemer theory passes from the impalpable ether, all through the different strata of the atmosphere to the lowest or densest, where the speed is estimated. Second—None of these phenomena can have a continued regular speed in any resisting medium. However quickly they might enter, their speed would naturally be retarded until their

* The time by the Roemer theory for light to traverse the space between the Earth and Jupiter in Opposition (about 8 5ᵐ 36ˢ now entirely disappears

power of penetration was exhausted. This, however, will not affect aberration as the few extra miles consequent to low altitudes would have but an insensible effect. In consequence of the above the writer is a firm believer in the theory of a perfect vacuum in space that existed previous to the invention of the theory of ether, and that light passes instantaneously, only being retarded when it plunges into a resisting medium, such, for example, as the atmosphere. The fact remains that since Dr. Bradley applied the motion of light to aberration the theory has been accepted by all great authorities, is the only one in use, and gives approximate, but never accurate results. But its application by Dr. Bradley was the relative speed of light and the earth's proper motion, the very thing that has finally led up to the solution which is to follow. As applied to the eclipses, it is only an artificial division of space and has never weakened the writer in his belief that the real cause of the phenomena lay somewhere else, but where? With absolutely no data to go by, it was hunting a needle in a haystack. Gleaning in all the fields of astronomical teaching produced but straws to be after thrown aside as useless, but with an innate certainty that the needle was in the stack, it was always a case of try again. Without further enumeration of trials and disappointments the thought occurred that when about to be eclipsed the satellites have a temporary proper motion of their own, independent of the motion as carried along by Jupiter and nearly on the same radius as the planet itself, and as the proper motion of the earth relative to the motion of light affects the longitude of the heavenly bodies, why should not the relative motion of the earth and satellites affect their longitude? The first trial was in applying aberration to the method as seen further on, and the result with two exceptions was very satisfactory and led right up to the truth. The method by aberration is inserted, for there are great possibilities in this little 20″ measure that practical astronomers will see and know well how to make use of.

This question finally resolves itself into the relative proper motion of the earth and satellites combined with distance. Light or movement of light having nothing at all to do with it.

Method, making use of Aberration, max. 20″.

Calling mean distance (Radius Vector) of Jupiter, 494,000,000 m.
" Jupiter's proper motion, ... 8 m.
" Earth's proper motion, ... 19 m.
" Periodic time of first satellite, . 42h., 27m. 33s.
" The Radius Vector of first satellite, 225,000 m.
Gives proper motion 9.318 + Jupiter 8 = 17,318 m.
" Aberration, ... 18″.23.
Calling mean distance in opposition $4\frac{1}{4}$ times the radius of Earth's orbit $\frac{4}{17}$ and in conjunction $6\frac{1}{4}$ times $\frac{4}{25}$.
Gives Angular effect in Opposition, . . 4″.290.
" " " " Conjunction, . . 2″.918.
" Constant mean aberration in Opposition, — 15″.710.
" " " " " Conjunction, + 22″.918.
" Difference, affects long. of satellite, 7″.208.
Jupiter's mean motion, . . . 1″ in 292s.
" Satellites at immersion, . . . 1″ in 134s.
Difference from Con. to Opp. 7″.208 × 134s = 16m. 4s.
Calling Periodic time fourth satellite, . . 16d. 16h. 31m. 50s.
" Radius Vector, ... 999,000 m.
Gives Proper motion at immersion 4.354 + 8 12,354 m.
" Aberration, ... 13″.
" Angular effect in Opposition, . . 3″.05.
" " " " Conjunction, . . 2″.08.
" Constant mean aberration in Opposition,—16″.95.
" " " " " Conjunction+22″.08.
" Difference, affects long. of satellite, 5″.13.
" Motion, 1″ in 189s. × 5″.13 . . = 16m., 8s.
Deduct for 1,000,000′ greater distance first sat. 3s. = 16m., 5s.
Difference, ... 1s.

When, as seen farther on, we add 60s. for change of distance the accumulated time carrying it to 17m., which is too great.

This being the mean, and as the result of this method is relative speed combined with distance, of course, on account of Jupiter's eccentricity, $\frac{1}{21}$ the accumulated time will be greater where the distance is less than the mean, so that the + 60s. and — 44s. will cause the accumulated time stand 16m., 04s. + 60s. = . . . 17m., 04s.

16m., 04s. — 45s. = . . . 15m., 19s.

Whole variation in accumulated time. . . . 1m., 45s.

Right here it is seen that aberration and the Roemer theory of transmission diverge, for whilst by the former the variation cannot exceed 1m. 45s., by the latter the variation can be as great as 3m. 30s., a difference of 1m. 45s. It is obvious that the two principles are not the same, although aberration was the plank on which the Roemer theory was floated. It is also seen that this method makes the accumulated time too great and it was easy to see that the reason lay in not being the true proportion—earth's motion to speed of light and earth's motion to motion of the satellites. Aberration is but the offspring of relative motion, and as we are looking for the very same thing (a change of longitude, but on a much smaller scale), it is the relative motion, a principle that produces aberration, we must make use of. Repeating the formula with relative speed, combined with distance, we get as follows:

Calling Jupiter's mean Radius Vector, . 494,000,000 m.
" Proper motion in a second, . . 8 m.
" Earth's proper motion in a second, 19 m.
" Periodic time first satellite, . . 42h., 27m., 33s.
" Radius Vector, ... 225,000 m.
Gives Proper motion at immersion 9.318 + 8 17.318 m.
Calling Jupiter's distance, when in Opposition. $4\frac{1}{4}$ times the earth, Radius Vector $\frac{4}{17}$ and when in Conjunction $6\frac{1}{4}$ times $\frac{4}{25}$.
Gives 17.318÷17 angular effect in Opposition = 4.076 m.
" 17.318÷25 " " " Conjunction 2.772 m.
" Constant mean aberration in Opposition = 14″.921 —
" " " " " Conjunction = 21″.772 +
Difference affects longitude of satellite, 6″.848

Jupiter's mean movement 1″ in 292s.=satellite 134s.

×6″.848, ...	= 15m., 17s.
Variation of distance on account of eccentricity,	+56s., 16m 13s.
" " " " "	—44s . 14m 33s.
Whole variation, ...	= 1m., 40s.

FOURTH SATELLITE.

Calling Periodic time. . . .	16d., 16h., 31m., 50s.
Radius Vector, . . .	999,000 m.
Gives Proper motion at immersion 4.354 + 8	12,354 m.
" Angular effect in Opposition, . .	2.908
" " " " Conjunction .	1.976
" Constant mean aberration in Opposition.	16″.092 —
" " " " " Conjunction,	20″.976 +
" Difference, longitude of satellite .	4″.844
Satellite moves 1″ in 189s. × 4″.884 =	15m., 23s.
By variation of distance, . .	+56s., 16m., 19s.
" " " " . .	—44s., 14m., 39s.
	1m , 40s.

There being 112 eclipses Con. to Opp. gives mean 8.189s. for each eclipse

By the theory of transmission we find a difference of 1m. 45s. in excess of this difference, which, divided by 112, gives less than 1s. for each eclipse.*

A difference is always found between the observed and calculated eclipses and attributed to probable irregularities in the movement of the satellite in its orbit. It is well to point out that such irregularities cannot be. The periodic times are found to be uniform, and as an entire revolution must necessarily take place for each eclipse, irregularities, if they exist, would all be covered in. Besides, the differences + 60s. and — 45s. makes the true proportion, variation by eccentricity is to mean radius as 1m. 45s is to mean accumulated time 15m. 17s. The trouble lies in too great a range of variation in the

* Of course the 1′45″ difference between the Roemer theory and Relative Speed is an accumulation of a half revolution of Jupiter in its orbit which, for successive years, would appear but a very small error.

accumulated time by the theory of transmission of light. By making use of the first and fourth satellites it is shown that all will come beautifully into line in accordance with Kepler's third law. Although in these calculations the writer has not aimed at absolute correctness, the very small difference of time 3s., counting greater distance between the first and fourth satellites, shows conclusively that they are very near the true quantities. Absolute correctness will not be obtained until the method is properly tabulated, which he has neither the time nor facilities to do. When that is done, it will give terrestrial longitude with perfect accuracy, what the Roemer theory can never do. With the exception of that theory this method changes nothing. But on the contrary enhances the value of aberration which by one of the fortuitous accidents that sometimes occur was derived from the relative movement of light and the earth's motion. Summing up we find the whole mean effect in longitude, which we may call, so to speak, in aberration of aberration to be in time 15m. 17s. That this quantity varies + 60s. and — 45s. on account of eccentricity and the motion of the earth in its orbit. The mean for each eclipse (1st satellite) 917s ÷ 112 = 8.189s or about $\frac{1}{120}$ of 1" in longitude. It is obvious that if there was no change of distances as in the sun, or as apparently so in the stars, this variation in the aberration of the satellites would not occur. There would be no variation in the times of the eclipses and that is all there is in it. The true solution of this problem casts no reflection on the illustrious Roemer. Had the observations of Dr. Bradley preceded his observations of the eclipses of the satellites, who knows but what the acute intellect of the former might have conceived the idea that light would be retarded on entering the atmosphere, and the principle of relative speed developed, that the latter would have applied it to the motion of the earth and the satellites. For the time in which he lived his thought nevertheless was a brilliant conception, that has performed the work reasonably well and resulted in great good in giving the world aberration, which in its turn has now given the truth. If in solving this problem the construction is clumsy and awkward the writer can only give as excuse his inexperience in putting together anything of this import.

LIBRARY OF CONGRESS
0 003 536 719 6